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The Impact of Environmental Performance Rating and Disclosure

An Empirical Analysis of Perceptions by Polluting Firms' Managers in China

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Abstract

Environmental performance rating and disclosure has emerged as a substitute or complement for traditional pollution regulation, especially in developing countries. Using data from China's Green Watch program, this study extends previous research on performance rating and disclosure by considering firms' perceptions of public and market responses to their ratings. The results suggest that the Green Watch has significantly increased market and stakeholder pressures on managers to improve their firms' environmental performance. More specifically, controlling for the characteristics of locations, firms, and individual managers, the analysis finds that firms with better ratings perceive positive impacts on market competitiveness, overall market value, and relationships with different stakeholders, while the firms with bad ratings are more likely to perceive deterioration. Among these factors, managers perceive a more active role for markets than for stakeholder relations.

This paper—a product of the Environment and Energy Team, Development Research Group—is part of a larger effort in the department to understand and improve environmental governance in developing countries.. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at hwang1@worldbank.org.

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Key words: environmental performance rating and disclosure, developing country, China's Green Watch Program

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1. Introduction

Environmental performance rating and disclosure (PRD) has emerged as a substitute or complement for traditional pollution regulation, especially in developing countries (Tietenberg, 1998; Dasgupta et al., 2006; Porney, 2000). Indonesia's PROPER (Program for Pollution Control, Evaluation and Rating), initiated in June 1995, was the first PRD program in developing countries. Because of its overall success, as measured by reduced emissions at a lower regulatory cost, many countries have established similar programs that are tailored to diverse economic, institutional and cultural settings. These programs include the Philippines' EcoWatch, India's Green Rating Project, China's Green Watch, Vietnam's Green Bamboo, Ghana's EPRD, and Ukraine's PRIDE. PRD programs are particularly attractive for developing countries because institutional weaknesses hinder conventional monitoring and enforcement of environmental laws, regulations, and standards (Foulon et al., 2002), and because PRD programs have lower regulatory costs (Dasgupta et al., 2006; Garcia et al., 2009).

PRD programs can be successful under two conditions. First, relevant parties - regulatory agencies, consumers, investors, communities and non-profit organizations (NGOs), - may react to firms' environmental performance, creating potential pressure on polluting firms. Second, firms must actually respond to this pressure by improving their environmental performance. The literature on PRD programs, mainly focused on empirical tests of the second condition, falls into two groups. The first compares the environmental performance ratings of firms before and after a program and ascribes improvement in environmental ratings to the program (Afsah et al 1997; Wang et al. 2004; Garcia et al. 2009). However, this approach may be confounded by time-varying factors such as technology improvements. The second group compares pollution levels between rated and unrated firms, and credits better environmental performance of rated firms to

the program. However, this approach may be confounded by selection bias (e.g., firms with better environmental performance may be more likely to be rated).

It is rare to have pollution data for both rated and unrated firms before and after a PRD program. Garcia et al. (2007 and 2009) are the researchers to address the effect of a PRD – Indonesia's PROPER -- on the measured pollution of rated and unrated firms, both ex ante and ex post. Their 2007 study suggests that PROPER has reduced emissions intensity, with a particularly rapid and strong impact on firms that have a poor initial compliance record. The 2009 study finds a strong reactive response during the first six months of disclosure, followed by a more moderate, but still significant, longer-run response as management adjusts to the new regime.

Using data from China's Green Watch program, this study extends previous research on PRDs by considering firms' perceptions of public and market responses to their ratings. The remainder of the paper is organized as follows. Section 2 reviews the relevant literature, focusing on the role of PRD programs in developing countries. Section 3 describes China's Green Watch program, while Section 4 describes our survey instrument and provides descriptive statistics for major variables. Section 5 presents our estimation model and results. Section 6 summarizes and concludes the paper.

2. Previous Research

The literature on pollution control includes extensive work on command-and-control, market-based and information-based instruments (Tietenberg 1998; Dasgupta et al. 2006; Garcia et al. 2007). Command-and-control instruments are often inefficient and ineffective in developing countries, because firms fail to report adequately, regulators lack the technical and administrative capacity for effective monitoring and enforcement, and judicial systems are weak

and/or corrupt. These same weaknesses limit regulators' ability to employ market-based instruments, which also work less effectively in countries where market failures are common and legal and institutional support for formal market activities is weak.

Information-based instruments can be effective in developing countries where strong regulatory institutions and/or well-developed markets are absent. In practice, diverse information programs have served as complements to command-and-control and market-based instruments (Kleindorfer and Orts 1998). They reduce the information asymmetry between polluters and environmental stakeholders (consumers, communities, NGOs, investors), empowering these stakeholders to pressure polluters for improved environmental performance (Bui and Mayer 2003; Kennedy, Laplante and Maxwell 1994; Oberholzer-Gee and Mitsunari 2006). When implemented correctly, information instruments promote better interaction and dialogue among firms, stakeholders and regulators (Garcia et al. 2007).

Information instruments also leverage markets in significant ways. An extensive empirical literature suggests that disclosure of firms' bad environmental performance reduces their stock prices both in developed countries (Foulon et al., 2002; Hamilton, 1995; Konar and Cohen, 1997; Khanna et al., 1998; Lanoie et al., 1998) and developing countries such as Argentina, Chile, Mexico, and the Philippines (Dasgupta et al., 2001). Jackson (2001) and Boyle and Kiel (2001) review the impact of disclosure on housing prices, which are found to be lower near Superfund sites (Kohlase, 1991; Reichert, 1999), hazardous waste sites (Thayer et al., 1992), non-hazardous landfills (Michaels and Smith, 1990), nuclear radiation sources (Gamble and Downing, 1992), and polluting manufacturing plants (Hanna, 2007). Housing prices also respond to publicized environmental contamination incidents (Kiel, 1995; Kiel and McClain, 1995).

Information instruments have diverse forms, including reports of measured pollution, environmental accident reports, and environmental performance ratings. In the US, for example, the Toxic Release Inventory (TRI) discloses toxic chemical releases and waste management activities by significant toxic polluters and federal facilities. In developing countries, however, weak regulatory institutions may have much greater difficulty in implementing such emissions inventories. In addition, despite an emerging literature on stakeholders' role in improving firms' environmental performance (Arora and Cason, 1998; Blackman and Bannister, 1998; Pargal and Wheeler, 1996; Wheeler et al., 1997), concerns remain about the public's ability to understand and utilize complex emissions reports. For example, Bui and Mayer (2003) find that the release of TRI's highly-detailed information on facilities' toxic emissions has virtually no effect on housing prices in neighboring areas, even when the release is unexpected. The dual problems of emissions inventories in developing countries – technical feasibility and public understanding – have led to a preference for programs that condense complex information into environmental performance ratings that are disclosed to the public.

Research on the effectiveness of performance rating and disclosure (PRD) programs suggests that that have a significant, positive impact on regulatory compliance (Afash et al., 1997; Dasgupta et al., 2006; Garcia et al., 2007, 2009; Wang et al., 2004). Dasgupta et al. (2006) summarize the changes in compliance rates for several PRD programs in Asia: One and two years after the inception of a PRD, compliance rates increased from 37% to 61% in Indonesia, 8% to 58% in the Philippines, 10% to 24% in Vietnam, 75% to 85% in Zhenjiang, China and 23% to 62% in Hohhot, China.

Several empirical studies also find that PRD programs have improved firms' environmental performance in Indonesia (Afash et al., 1997; Garcia et al., 2007, 2009) and China (Wang et al.,

2004). However, data constraints generally limit these studies to comparisons of environmental ratings before and after program implementation, or comparisons of compliance status between rated and unrated firms. Unfortunately, intertemporal rating comparisons are subject to confounding effects from time-varying factors such as technology change, while cross-sectional comparisons can be subject to significant selection bias.

3. China's Green Watch Program

Despite long-standing efforts to control pollution with traditional regulatory instruments, China continues to have severe pollution problems. This has led China's State Environmental Protection Administration (SEPA) to test the effectiveness of environmental performance rating and disclosure in a program supported by the World Bank. In 1999, SEPA launched its Green Watch program in Zhenjiang City, Jiangsu Province and Hohhot City, Inner Mongolia Autonomous District. Zhenjiang implemented a relatively complex rating system, as shown in Figure 1, while Hohhot used a simpler rating system that was suited to its lower level of economic and institutional development (Wang et al., 2004). As shown in Figure 1, Green Watch rates firms' environmental performance from best to worst in five colors – green for superior performance, blue for full compliance, yellow for meeting major compliance standards but violating some minor requirements, red for violating important standards, and black for more extreme non-compliance.

The first Green Watch ratings were disclosed through the media in 1999. The program was extended from Zhenjiang to the entire Jiangsu Province in 2001, and to eight other provinces during 2003-2005. Nationwide implementation of Green Watch has been promoted since 2005. Overall, the available evidence suggests a positive impact for the program. Table 1 shows that in Zhenjiang, the percentage of firms with positive ratings (green, blue and yellow) increased from

75% in 1999 to 85% in 2000. The most significant changes were in the extremely-noncompliant black group, whose percentage dropped from 11% in 1999 to 2% in 2000, and a major shift from the partially-compliant yellow group (44% to 22%) to the fully-compliant blue group (27% to 61%).

Evidence for the Green Watch program throughout Jiangsu Province indicates both increasing participation by firms and improvement in their compliance rates. As shown in Table 1, the number of rated firms increased more than tenfold, from 1,059 in 2001 to 11,215 in 2006; and the percentage of firms with positive ratings (green, blue, and yellow) increased from 83% in 2001 to 90% in 2006. Furthermore, Table 1 suggests that Green Watch ratings provide a strong improvement incentive for noncompliant (red and black) firms, with stronger effects on firms with red ratings (moderate noncompliance) than those with black ratings (extreme noncompliance).

4. Survey Data and Descriptive Statistics

The results reported in this paper are drawn from a 2002 survey of managers of firms rated by Green Watch in four cities in Jiangsu Province of China: Huaian, Wuxi, Yangzhou, and Zhenjiang. Following the success of the pilot program in Zhenjiang, Huaian, Wuxi and Yangzhou adopted the same program in 2001. Table 2 provides information on socioeconomic and environmental conditions in the four cities, as well as polluting emissions in 2001. Wuxi has the largest population as well as the highest GDP per capita, while Huaian is the poorest. Wuxi and Yangzhou have the lowest readings for air quality, measured by SO2 (sulfur dioxide) and NO2 (nitrogen dioxide), and water quality measured by TSS (total suspended solids) and regulatory compliance percentage.

We used the same format to conduct the surveys in all four cities in late 2002. The municipal environmental bureau of each city convened meetings of managers from all rated firms. During the meetings, the managers were asked to anonymously complete the questionnaires administered by the research team. Of 344 rated firms, the managers of 225 firms attended the meetings and completed the questionnaires. Among those 225 firms, 71 had their first Green Watch ratings assigned in 2000, 76 in 2001 and 78 in 2002. Across the four cities, Huaian had 41 firms surveyed, Wuxi 21, Yangzhou 45 and Zhenjiang 118.

The survey questionnaire has six sections that ask for managers' socio-demographic information; perceptions of local environmental conditions; their firms' relationships with different stakeholders; actions undertaken to control pollution and improve environmental performance in the previous year; general understanding of and experience with the Green Watch Program; and perceptions of the changes in their firm's market value, competitiveness, , and relationships with different stakeholders that were attributable to Green Watch. Appendix A lists the major survey questions on perceived changes by the firm managers. A complete survey is available upon request.

Table 3 summarizes the managers' responses. Wuxi, the highest-income city, has the lowest rating for overall environmental conditions (36.7 out of 100), while Haian is rated 67.7, Zhengjiang 70.7, and Yangzhou 74.2. Managers of large firms dominate the ratings in Wuxi, with 57% of responses, while managers of medium firms have greater representation in the other cities. State-owned enterprises predominate, except in Yangzhou. Private, foreign, and joint venture companies are all significantly represented. In Wuxi, rated firms are concentrated in the textile industry and located in zones with a mixture of industrial, commercial and residential activity. In Yangzhou, firms in the mechanical and electric manufacturing industry have the

greatest representation (33%). More than half of the rated firms in Huaian, Yangzhou, and Zhenjiang are focused on the domestic market, while a higher proportion of rated firms in Wuxi are export-oriented. The surveyed managers have similar characteristics across the four cities: predominately males in their 40s, with 12-13 years of schooling and more than a decade of employment in their current jobs.

Figure 2 provides information on managers' perceptions of the relationship between Green Watch ratings and measures of market value and competitiveness. Gains in market value are perceived by 75% of the managers whose firms got the highest rating (green), but less than 20% of the managers whose firms got the lowest rating (black). Among managers of black-rated firms, one-third perceive a loss of international competitiveness, while the other managers see no change in international status. The majority of red-rated firms perceive no change or a loss in international competitiveness. On the other hand, almost none of the firms rated blue or green perceive a loss in competiveness, while the majority perceive an improvement. Similar patterns characterize perceptions of firms' competitiveness in the domestic market: 80% of black-rated firms perceive their domestic competitiveness as unchanged or reduced, while 75% of green-rated firms perceive a gain.

Figure 2 also suggests a positive relationship between ratings and relationships with stakeholders. Two-thirds of the green-rated firms perceive an improved relationship with regulatory agencies, in contrast to 20% of the firms rated black and 42% of those rated red. A similar pattern holds for relationships with neighboring communities: Improvements are perceived by 0% for black-rated firms, 21% for red; 8% for yellow, 18% for blue, and 42% for green. Similar patterns emerge for relationships with NGOs, the media, industry associations

and financial institutions. In the latter case, percentages who perceive improvements are, by color: red 5%, yellow 18%, blue 37% and green 58%.

5. Multivariate Analysis

5.1 Estimation Model

While descriptive statistics are interesting and suggestive, more insight can be gained from a multivariate approach. In this section, we specify and estimate a set of reduced-form equations that control for the attributes of firms, managers and locations. To illustrate our approach, we specify competitiveness in the domestic market for firm *i*, denoted Z_i^*, as a latent variable that is affected by the firm's publicly-disclosed environmental performance rating, as well as other firm and location characteristics. The manager's characteristics also enter, because they may affect perceptions of the firm's competitiveness. For firm *i* in city *j*, we specify competitiveness as

$$(1)\quad Z_i^* = \boldsymbol{\beta}_1 \mathbf{F}_i + \boldsymbol{\beta}_2 \mathbf{M}_i + \boldsymbol{\beta}_3 \mathbf{C}_j + \boldsymbol{\beta}_4 \mathbf{R}_i + \varepsilon_i ,$$

where $\mathbf{F_i}$, $\mathbf{M_i}$, and $\mathbf{C_j}$ are vectors of characteristics of the firm, the manager, and the city. $\mathbf{R_i}$ is a vector of the five color ratings. The coefficient vectors are denoted by $\boldsymbol{\beta}$'s, while ε_{ij} is a random error term that follows a Weilbull distribution.

While the firm's competitiveness cannot be observed, we do observe the manager's choice among three survey alternatives, deteriorated, no change, and improved, that are respectively indicated by $k = 1, 2$, and 3. Formally we model the change Z_i as follows:

$$(2)\quad Z_i = \begin{cases} 1 & \text{if } Z_i^* \le U_1 , \\ 2 & \text{if } U_1 < Z_i^* \le U_2 , \\ 3 & \text{if } U_2 < Z_i^* . \end{cases}$$

The U's are unknown parameters to be estimated with the **β**'s. The probability of the manager of firm i selecting choice k is

$$(3)\quad P_{ik} = \begin{cases} \dfrac{1}{1+\exp(-U_1+W_i)} & \text{if } k=1, \\ \dfrac{1}{1+\exp(-U_2+W_i)} - \dfrac{1}{1+\exp(-U_1+W_i)} & \text{if } k=2, \\ 1 - \dfrac{1}{1+\exp(-U_2+W_i)} & \text{if } k=3; \end{cases}$$

where $W_i = \boldsymbol{\beta}_1 \mathbf{F}_i + \boldsymbol{\beta}_2 \mathbf{M}_i + \boldsymbol{\beta}_3 \mathbf{C}_i + \boldsymbol{\beta}_4 \mathbf{R}_i$. Given the nonlinear nature of equation (3), the marginal effects of the regressors that are continous variables ($\boldsymbol{X}$ = [**F**, **M**, **C**, **R**]) on the probabilities are

$$(4)\quad \frac{\partial P_{ik}}{\partial \mathbf{X}} = P_{ik}(1-P_{ik})(-\boldsymbol{\beta}) \ .$$

Equation (4) suggests that the marginal effects of the continuous regressors have opposite signs from the coefficients of the regressors. Since some of the key regressors are dummy variables, we provide an interpretive illustration for environmental performance ratings. Assume that the yellow color rating is used as a base. The marginal effect of receiving a red color rating is the difference in the probability P_{ik} for k = 1, 2, and 3 resulting from the color change from yellow to red, while keeping other regressors constant at their sample means.

The same ordered logit model can be applied to analyze the perceived changes in firms' market value, and relationships with different stakeholders.

5.2 Results

We have applied our ordered logit model to 10 indicators for firms: overall market value, competitiveness, and relationships with different stakeholders. In each model, the dependent

variable has three categorical values 1, 2 and 3, indicating perceived deterioration, no change, or improvement on each measure. The regressors include managers' characteristics (gender, age, year of schooling, and tenure), firms' attributes (ownership, size, sector, zoning, and market concentration); city characteristics (measured by attribute dummies and overall environmental conditions); and color ratings.

Tables 4 and 5 report our estimation results. Controlling for the characteristics of firms, cities and managers, we find that corporate environmental performance ratings are statistically significant in the majority of the models. We calculate marginal effects for the probabilities that a managers states a deterioration ($k = 1$) or improvement ($k = 3$) for each variable. Since performance ratings are categorical, the marginal effect is measured by the difference in the probability when a color rating dummy changes from zero to one. As our base for estimation, we use firms rated yellow (complying with the majority of regulatory standards but failing to meet some minor standards). The marginal effect of a particular color rating (e.g. green) is the probability change when the rating changes from yellow (the base) to that color. Table 6 summarizes the marginal effects of the color ratings on each measure.

Relative to yellow-rated firms, the probability of perceiving a gain in market value decreases by 20 percent points for red-rated firms, at the 1% level of statistical significance.[i] In contrast, the probability of perceiving a gain increases by 27% points for blue firms and 68% for green firms. For international competitiveness, firms rated blue and green experience a decrease of 6-7% in perceived deterioration, in contrast to increases in perceived improvement of 24% for blue firms and 46% for green firms. On the other hand, the probability of perceived improvement in international competitiveness decreases by 16% for black firms and 37% for red firms, while the

probability of perceived deterioration increases by 22% for red firms. We find similar results for firms' competitiveness in the domestic market, and within their own industries.

Corporate environmental performance ratings also influence firms' relationships with different stakeholders. A green rating increases the probability of perceiving an improved relationship with environmental agencies by 44%, NGOs by 23%, and industry associations by 18%, while also decreasing the probability of a deteriorated relationship with environmental agencies (1%), communities (18%), NGOs (15%), the media (24%) and industry associations (13%). The direction of blue impacts is similar, but the estimated marginal impacts are much smaller. In this context, we should note that two rules applied in Jiangsu Province may also affect the differential impacts of blue and green ratings: (a) Enterprises awarded green in a particular year can be given priority consideration in the selection of best-performance enterprise activities; and (b) an enterprise that has won green for three consecutive years is given preferential status by provincial regulators.

Our results indicate the opposite effects for bad performers. A black rating decreases the probability of perceiving an improved relationship with communities (10% less), NGOs and the media (7%), industry associations (5%), and financial markets (21%). Red-rated firms are less likely to perceive an improved relationship with industry associations (4% less) and financial markets (20%), while they have a higher probability of perceiving a deteriorated relationship with financial markets (6% more).

Overall, one notable finding is that corporate environmental performance ratings are more likely to have statistically significant impacts on market value and market competitiveness than on relationships with stakeholders. This suggests that in China, at least, markets may be a more powerful determinant of rating impacts than communities, NGOs and the media.

6. Conclusions

In this paper, we report survey-based results for firms' experiences with China's Green Watch programs in four cities of Jiangsu Province. The results suggest that Green Watch has significantly increased market and stakeholder pressure on managers to improve their firms' environmental performance. More specifically, controlling for the characteristics of locations, firms, and individual managers, we find that firms with better ratings perceive positive impacts on market competitiveness, overall market value, and relationships with different stakeholders, while the firms with bad ratings are more likely to perceive deterioration. Among these factors, managers perceive a more active role for markets than for stakeholder relations.

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Table 1. Firms' Environmental Performance Ratings by the Green Watch Program in Jiangsu Province, China

	Year	Green	Blue	Yellow	Red	Black	Total
Pilot program in Zhenjiang City	1999	3 (3.30)	25 (27.47)	40 (43.96)	13 (14.29)	10 (10.99)	91
	2000	2 (2.10)	58 (61.05)	21 (22.11)	12 (12.63)	2 (2.10)	95
Province-wide program	2001	77 (7.27)	512 (48.35)	288 (27.20)	141 (13.31)	41 (3.87)	1059
	2002	182 (7.26)	1196 (47.69)	655 (26.12)	398 (15.87)	77 (3.07)	2508
	2003	267 (8.69)	1545 (50.26)	789 (25.67)	367 (11.94)	106 (3.44)	3074
	2004	329 (6.46)	2659 (52.20)	1467 (28.80)	525 (10.31)	114 (2.24)	5094
	2005	530 (6.62)	4016 (50.17)	2614 (32.65)	702 (8.77)	143 (1.79)	8005
	2006	702 (6.26)	5414 (48.27)	3944 (35.17)	1000 (8.92)	155 (1.38)	11215

Figures inside parentheses are percents of the firms rated in particular color.

Source: The rating information of the pilot program in Zhenjiang is obtained from Wang et al. (2004). Legislative Affair Office of the China State Council (2007) provides the rating information of the province-wide Green Watch Program in Jiangsu province in 2001-2006 (available at http://www.chinalaw.gov.cn/article/dfxx/dffzxx/js/200706/20070600021431.shtml; last assess on May 19, 2009).

Table 2. City Comparisons on socio-economic and environmental conditions as well as industrial pollution emissions of 2001

	Huaian	Wuxi	Yangzhou	Zhenjiang
Socio-economic conditions				
GDP per capita (Yuan)	14,359	37,700	21,311	18,852
Economic growth rate (%)	11.05	12.20	7.30	11.10
Unemployment rate (%)	3.84	3.62	3.60	2.30
Population (1,000)	558	2,131	1,097	628
Environmental conditions				
TSS: Total suspend solids (mg / m3)	0.158	0.144	0.237	0.105
SO2: sulfur dioxide (mg / m3)	0.037	0.056	0.023	0.024
NO2: nitrogen dioxide (mg / m3)	0.027	0.034	0.035	0.038
% of drinking water meeting standards	93.00	97.96	98.80	96.43
% of surface water meeting standards	83.00	91.67	62.00	88.89
Noise (dB(A))	55.80	56.90	53.20	55.50
Total industrial pollution emission				
waste water (10,000 ton)	1674	14010	3774	4544
COD (ton)	1708	N.A.	6787	25200
Waste gas (100 million m^3)	129	471	461	1895
Smoke (ton)	11063	8611	5385	47421
SO2 (ton)	8863	21492	35765	96377
solid waste (10,000 ton)	1	8	N.A.	265

Source: Municipal governments of the four cities.

Table 3. Summary statistics of characteristics of cities, firms, and managers in the sample

	Huaian	Wuxi	Yangzhou	Zhenjiang	Total
No. of observations	41	21	45	118	225
Overall envi. conditions [a]	67.68	66.81	74.22	70.69	70.48
Firm characteristics					
Age (years)	31.02	36.00	35.98	25.33	29.49
Firm size (%)					
big	14.63	57.14	30.23	15.38	22.07
medium	46.34	42.86	51.16	48.72	48.20
Small	39.02	0.00	18.60	35.90	29.73
Ownership (%)					
State-owned	46.34	52.38	28.89	37.29	38.67
Collectively owned	9.76	0.00	11.11	15.25	12.00
Private	19.51	9.52	8.89	14.41	13.78
Foreign	2.44	0.00	0.00	5.93	3.56
Joint venture	7.32	23.81	17.78	19.49	17.33
Others	14.63	14.29	33.33	7.63	14.67
Sector (%)					
Mechanical & electric	13.16	23.81	33.33	24.79	24.31
Textile	13.16	42.86	16.67	7.69	13.76
Chemical	10.58	9.52	2.38	12.82	10.09
Utility	5.26	0.00	2.38	5.13	4.13
Food & beverage	13.16	4.76	7.14	4.27	6.42
Others	44.74	19.05	38.10	45.30	41.28
Zoning (I = industrial; C = commercial; L = Living) (%)					
I	30.00	14.29	33.33	43.22	36.16
I + C + L	45.00	66.67	51.11	43.22	47.32
Without I	25.00	19.05	15.56	13.56	16.52
Major market (%)					
Domestic	60.98	42.86	59.09	61.21	59.01
Export	21.95	33.33	22.73	25.00	24.77
Domestic + export	17.07	23.81	18.18	13.79	16.22
Managers' characteristics					
Gender (%)	92.68	80.95	82.22	90.68	88.44
Age (years)	44.73	39.00	43.71	44.42	43.83
Schooling (years)	13.02	13.05	13.73	12.55	12.92
Tenure (years)	16.85	14.38	18.84	13.27	15.14

[a] The managers' perceptions of overall environmental quality is on a scale from one (the worst) to 100 (the best).

Table 4. Estimation results on the impact of environmental performance ratings on firm competitiveness, market value, and internal environmental management

	market competitiveness			Overall market value
	International. Market	Domestic market	Within industry	
color rating dummies (base = yellow)				
black	-0.70**	-1.19	0.76**	0.5
	(0.34)	(1.62)	(0.32)	(1.93)
red	-1.94***	-1.58***	-1.72***	-1.37*
	(0.35)	(0.28)	(0.30)	(0.71)
blue	1.04***	0.98***	1.01***	1.50***
	(0.24)	(0.34)	(0.36)	(0.34)
green	2.31***	1.97*	1.47	3.55***
	(0.38)	(1.02)	(0.90)	(0.75)
City characteristics				
local envi. cond.	0.01***	0.01	0.00	-0.01***
	0.00	(0.01)	(0.01)	0.00
city dummies (base = Wuxi)				
Huaian	-0.37	-0.62***	2.44***	-0.85***
	(0.38)	(0.21)	(0.29)	(0.09)
Yangzhou	-0.05	-0.45**	-0.56	-1.37***
	(0.47)	(0.18)	(0.34)	(0.30)
Zhenjiang	-0.28	0.24***	-0.27*	-0.69***
	(0.39)	(0.08)	(0.17)	(0.21)
Managers' characteristics				
male	0.34	0.31	0.19	0.38
	(0.25)	(0.44)	(0.19)	(0.67)
age (years)	0	0	-0.01	-0.01
	(0.02)	(0.02)	(0.01)	(0.01)
years of schooling	0.08**	0.08**	0.01	0.01
	(0.04)	(0.03)	(0.01)	(0.03)
tenure (years)	0.02	0.02**	0.03	0.01
	(0.01)	(0.01)	(0.03)	(0.02)
Firm characteristics				
ownership (base = State owned)				
Collective	-0.22	-0.39*	0.16	-0.56
	(0.84)	(0.23)	(0.27)	(0.44)
Private	0.15	0.31	0.63	-0.15
	(1.21)	(0.65)	(0.52)	(0.53)
joint venture	0.35	0.06	0.05	-0.90**

	(0.64)	(0.38)	(0.42)	(0.36)
Foreign invested	-0.02	-0.02	0.24	0.4
	(0.86)	(0.40)	(0.44)	(0.43)
Others	1.15	1.65*	1.81*	1.47**
	(0.92)	(0.85)	(1.02)	(0.59)
firm size				
medium	0.80*	-0.12	0.47*	0.43
	(0.46)	(0.21)	(0.28)	(0.35)
small	0.55	0.54*	0.37	0.83***
	(0.50)	(0.29)	(0.37)	(0.23)
firm age (years)	0	-0.01**	-0.01***	-0.01
	(0.01)	0.00	0.00	(0.01)
textile	-0.45	-0.55	-0.24	0.06
	(0.73)	(0.46)	(0.56)	(0.62)
chemical	0.07	0.02	-0.11	0.32**
	(0.63)	(0.48)	(0.79)	(0.13)
utility	-2.28***	-0.24	-0.47	-1.16
	(0.29)	(0.47)	(0.82)	(1.31)
food & beverage	0.19	0.99*	-0.68*	-0.52
	(0.50)	(0.58)	(0.39)	(0.39)
others	0.41	0.29	0.38	-0.04
	(0.99)	(0.84)	(0.67)	(0.09)
zoning of a firm (base = industrial zone)				
commercial+ind.+ living	0.55***	0.56*	0.32**	0.01
	(0.19)	(0.33)	(0.13)	(0.35)
No industry	1.48**	0.81***	0.76***	0.73
	(0.69)	(0.24)	(0.26)	(0.47)
major market (base = domestic)				
export	0.23	0.22	0.23	-0.54
	(0.16)	(0.48)	(0.62)	(0.41)
domestic+export	0.77***	0.77**	0.22	-0.89***
	(0.22)	(0.31)	(0.27)	(0.23)
cutoff 1 (U_1)	1.33***	-0.23	-2.09	-5.28***
	(0.46)	(0.61)	(1.28)	(1.37)
cutoff 2 (U_2)	4.28***	3.36***	1.21	0.62
	(0.59)	(0.51)	(1.17)	(1.26)
R-squared	0.19	0.16	0.20	0.19
No. of observations	127	199	213	214

Figures in parentheses are standard deviations of the estimated coefficients. Asterisks, ***, **, and *, represent the 1%, 5%, and 10% significance level, respectively.

Table 5. Estimation results of the impact of environmental performance ratings on firms' relationships with different stakeholders

	Firms' relationship with different stakeholders					
	Envi. authorities	Community	NGOs	Media	Industry association	Financial markets
color rating dummies (base = yellow)						
black	-1.70	-1.67	-2.83**	-1.65	-1.79	-2.17
	(1.99)	(1.45)	(1.36)	(1.46)	(1.36)	(1.59)
red	0.54	-0.11	-0.47	0.37	-1.08*	-1.63***
	(0.37)	(0.90)	(0.89)	(0.45)	(0.58)	(0.20)
blue	0.41***	0.88	0.99	1.49***	0.28	1.04***
	(0.10)	(0.61)	(0.67)	(0.34)	(0.69)	(0.35)
green	1.88*	1.5	1.78***	2.03*	1.66***	1.16
	(0.97)	(0.93)	(0.61)	(1.09)	(0.60)	(1.14)
City characteristics						
local envi. cond.	0.00	0.00	-0.01	0.00	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
city dummies (base = Wuxi)						
Huaian	-1.26***	0.64*	-0.92*	-0.93***	0.63	-0.97***
	(0.43)	(0.39)	(0.54)	(0.32)	(0.48)	(0.20)
Yangzhou	-0.83**	0.92*	-0.1	-0.24	0.93**	-1.42***
	(0.38)	(0.53)	(0.48)	(0.36)	(0.41)	(0.15)
Zhenjiang	-1.20**	0.83**	-0.32	-0.78	0.44	-0.71***
	(0.53)	(0.34)	(0.62)	(0.48)	(0.45)	(0.21)
Managers' characteristics						
male	-0.21***	0.34***	0.42	1.03***	1.28***	0.38
	(0.08)	(0.12)	(0.55)	(0.22)	(0.14)	(0.61)
age (years)	0	-0.02	-0.01	0	-0.01	-0.05**
	(0.01)	(0.03)	(0.03)	(0.04)	(0.03)	(0.02)
years of schooling	-0.02	-0.03**	-0.02	0.02	0.03	0.01
	(0.03)	(0.01)	(0.02)	(0.01)	(0.05)	(0.02)
tenure (years)	-0.01	-0.01	-0.02	-0.02	-0.04	0.02
	(0.01)	(0.02)	(0.03)	(0.02)	(0.03)	(0.01)
Firm characteristics						
ownership (base = State owned)						
Collective	-0.09	0.96***	0.32**	-0.05	0.72***	-0.81
	(0.18)	(0.29)	(0.15)	(0.16)	(0.15)	(0.88)
Private	0.05	0.85	0.22	-0.29	0.24	0.2
	(0.62)	(0.90)	(0.88)	(0.89)	(0.51)	(0.37)
Joint venture	0.34	0.57**	0.36	0.77	1.55***	-1.02***
	(0.22)	(0.23)	(0.34)	(0.68)	(0.54)	(0.28)
Foreign invested	0.27	0.69	0.51	0.35	1.38***	0.37

	(0.24)	(0.51)	(0.48)	(0.36)	(0.14)	(0.48)
Others	0.22	1.02	1.05	1.00*	1.66***	0.89
	(0.58)	(0.76)	(0.70)	(0.58)	(0.64)	(0.66)
firm size (base = large)						
Medium	0.84*	0.45	0.93***	1.20***	0.93***	-0.74**
	(0.43)	(0.33)	(0.33)	(0.40)	(0.15)	(0.35)
Small	0.95	0.36	1.35***	1.46***	1.13***	0.01
	(0.68)	(0.33)	(0.43)	(0.46)	(0.29)	(0.24)
firm age (years)	0.01	-0.01**	0	-0.02***	-0.01	-0.02
	(0.01)	(0.01)	(0.01)	0.00	(0.01)	(0.02)
sector dummies (base = mechanical and electrical manufacturer)						
Textile	-0.29	-0.67	-0.53	-0.81*	-1.14*	0.03
	(0.79)	(0.48)	(0.86)	(0.45)	(0.62)	(0.58)
chemical	0.65	-0.92	0.56	0.29	0.24	-0.3
	(0.54)	(0.66)	(0.53)	(0.46)	(0.42)	(0.45)
utility	1.66	-1.70**	-1.29**	-0.54	-1.86***	-0.19
	(1.21)	(0.81)	(0.52)	(0.61)	(0.63)	(1.72)
food & beverage	-1.43**	-0.44	0.24	0.14	-0.59	0.25
	(0.70)	(0.56)	(0.55)	(0.61)	(0.58)	(0.36)
Others	0.06	-0.41	-0.5	-0.19	-0.32	0.06
	(0.17)	(0.58)	(0.42)	(0.27)	(0.24)	(0.42)
zoning of a firm (base = industrial zone)						
commercial + +industry + living	-0.21	-0.68**	-0.57	-0.46	-0.33***	0.22
	(0.49)	(0.32)	(0.76)	(0.71)	(0.09)	(0.35)
zone without industry	0.32	-0.83	-0.99	-0.43	-0.35	0.43
	(0.39)	(0.70)	(0.86)	(0.78)	(0.84)	(0.43)
major market (base = domestic)						
Export	0.49	-0.46**	-0.2	0.34	0.1	-0.18
	(0.32)	(0.23)	(0.29)	(0.33)	(0.35)	(0.37)
Domestic+export	0.48	0.3	0.56	1.14***	0.66	0.72
	(0.57)	(0.35)	(0.39)	(0.25)	(0.44)	(0.55)
cutoff 1 (U_1)	-4.28***	-1.91	-2.30**	-0.26	-1.91	-6.25**
	(1.07)	(1.58)	(1.15)	(1.88)	(1.75)	(2.49)
cutoff 2 (U_2)	0.99	1.28	1.85	3.16*	2.57*	-1.02
	(1.30)	(1.64)	(1.23)	(1.72)	(1.54)	(2.33)
R-squared	0.084	0.158	0.163	0.181	0.226	0.177
No. of observations	212	212	212	211	212	213

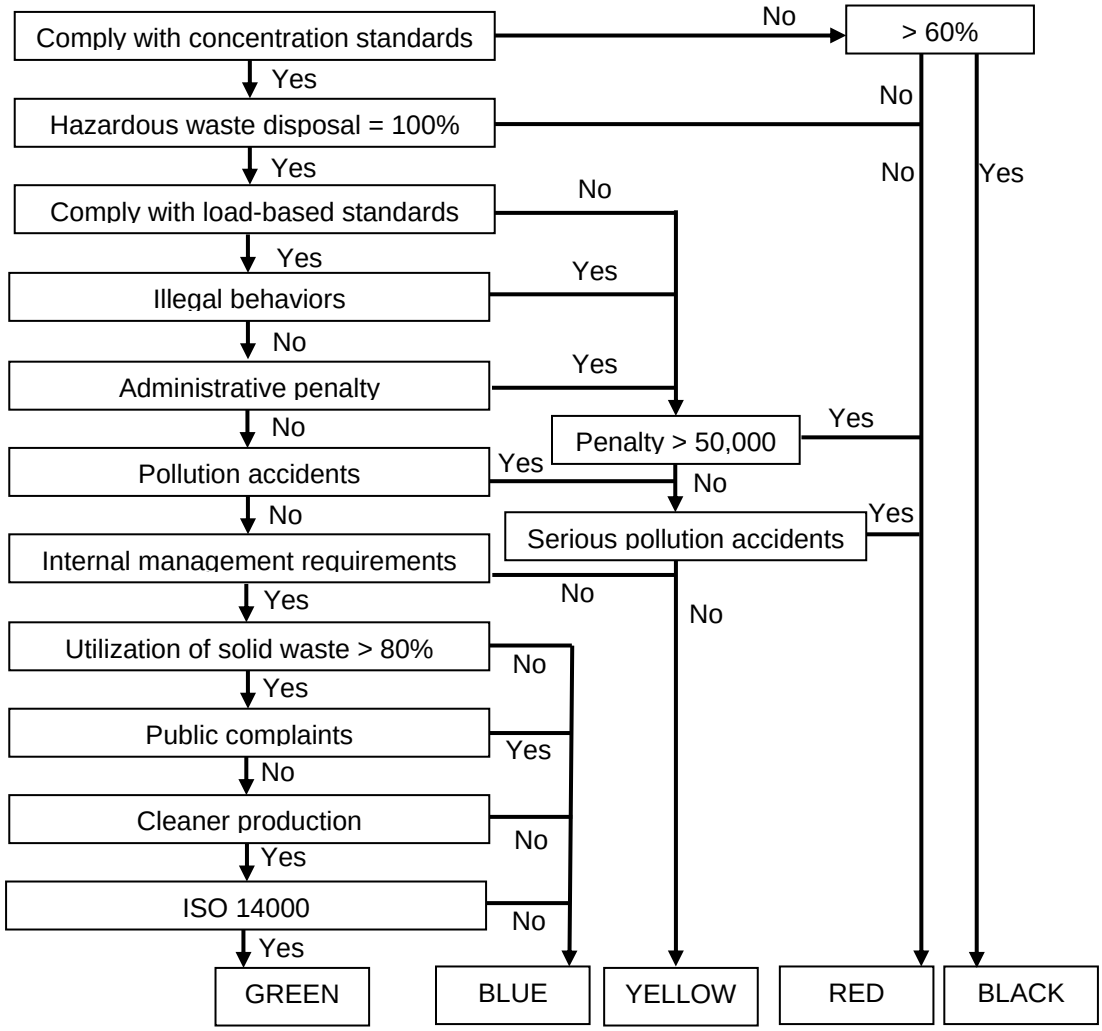
Figures in parentheses are standard deviations of the estimated coefficients. Asterisks, ***, **, and *, represent the 1%, 5%, and 10% significance level, respectively.

Table 6. Marginal effects of corporate environmental performance ratings based on the ordered logit model controlling for characteristics of firms, managers, and cities (base color rating = yellow)

	Overall	Market competitiveness			Relationships with different stockholders					
	market value	intl. market	domestic market	within industry	envi. agencies	community	NGOs	media	Industry Assoc.	financial markets
Marginal effect on the probability that firm managers indicate an deterioration (k = 1)										
Black	0.00	0.05	0.07	-0.02*	0.04	0.38	0.60**	0.39	0.36	0.11
	(0.01)	(0.05)	(0.14)	(0.01)	(0.08)	(0.34)	(0.24)	(0.33)	(0.33)	(0.17)
Red	0.02	0.22**	0.10*	0.10***	0.00	0.02	0.07	-0.07	0.18	0.06***
	(0.01)	(0.11)	(0.05)	(0.02)	0.00	(0.17)	(0.16)	(0.08)	(0.11)	(0.01)
Blue	-0.01***	-0.07**	-0.04**	-0.03**	-0.00*	-0.17	-0.15	-0.32***	-0.04	-0.02
	(0.00)	(0.03)	(0.02)	(0.02)	(0.00)	(0.13)	(0.11)	(0.08)	(0.09)	(0.01)
green	-0.01***	-0.06***	-0.03***	-0.02***	-0.01***	-0.18***	-0.15***	-0.24***	-0.13***	-0.01
	(0.00)	(0.02)	(0.01)	(0.00)	(0.00)	(0.07)	(0.03)	(0.06)	(0.02)	(0.01)
Marginal effect on the probability that firm managers indicate an improvement (k = 3)										
Black	0.11	-0.16**	-0.25	0.17***	-0.26	-0.10***	-0.07***	-0.07**	-0.05***	-0.21***
	(0.46)	(0.08)	(0.25)	(0.07)	(0.16)	(0.03)	(0.01)	(0.03)	(0.01)	(0.06)
red	-0.20***	-0.37***	-0.31***	-0.38***	0.13	-0.01	-0.03	0.03	-0.04***	-0.20***
	(0.07)	(0.05)	(0.04)	(0.05)	(0.09)	(0.09)	(0.04)	(0.04)	(0.01)	(0.01)
Blue	0.27***	0.24***	0.23***	0.25***	0.09***	0.08	0.06*	0.10***	0.02	0.17***
	(0.05)	(0.05)	(0.07)	(0.08)	(0.02)	(0.05)	(0.03)	(0.02)	(0.04)	(0.05)
green	0.68***	0.46***	0.43***	0.30**	0.44**	0.24	0.23*	0.30	0.18**	0.26
	(0.06)	(0.05)	(0.15)	(0.13)	(0.18)	(0.20)	(0.13)	(0.23)	(0.09)	(0.28)

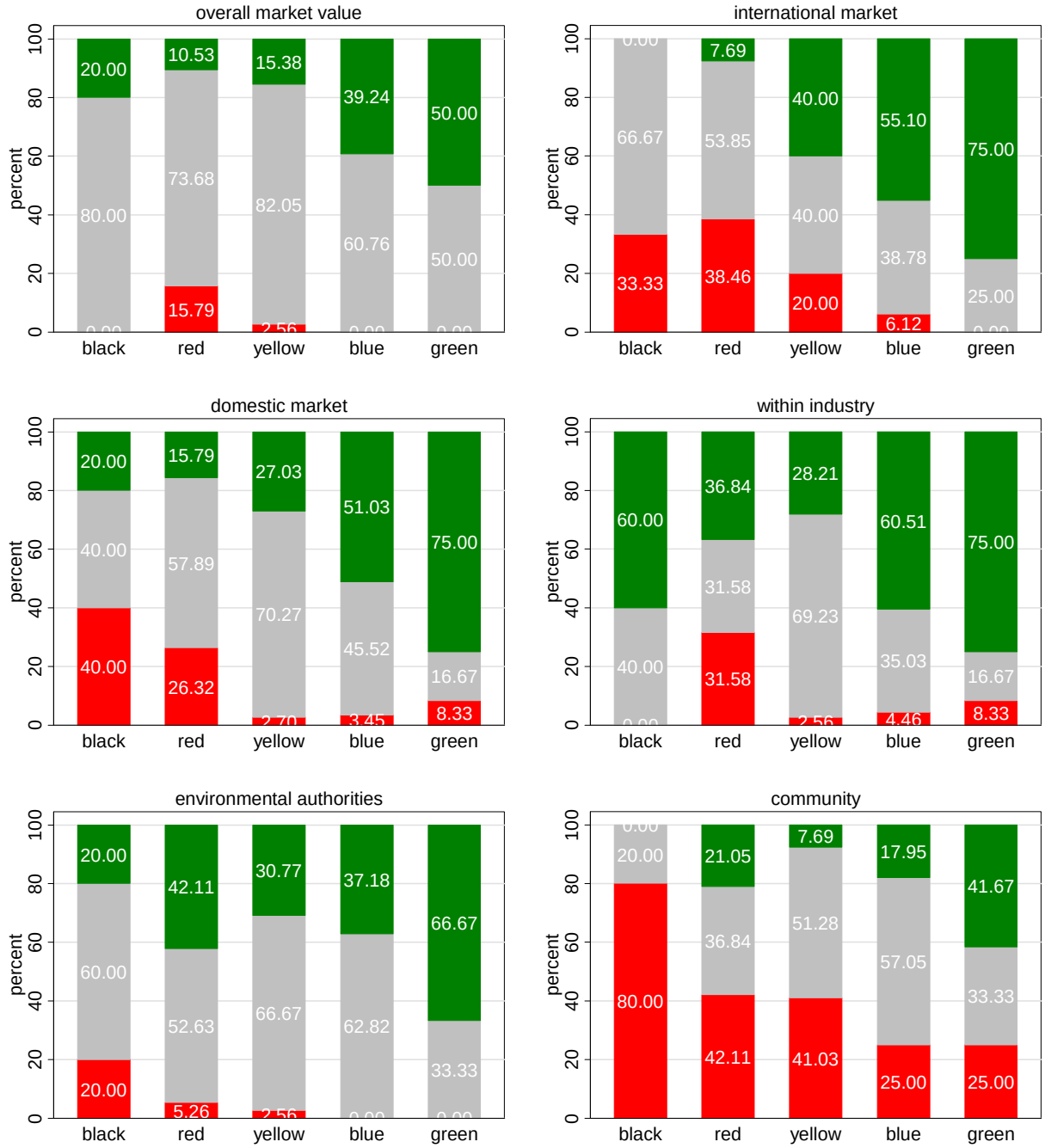
Figures in parentheses are standard deviations of the marginal effects. Asterisks, ***, **, and *, represent the 1%, 5%, and 10% significance levels, respectively.

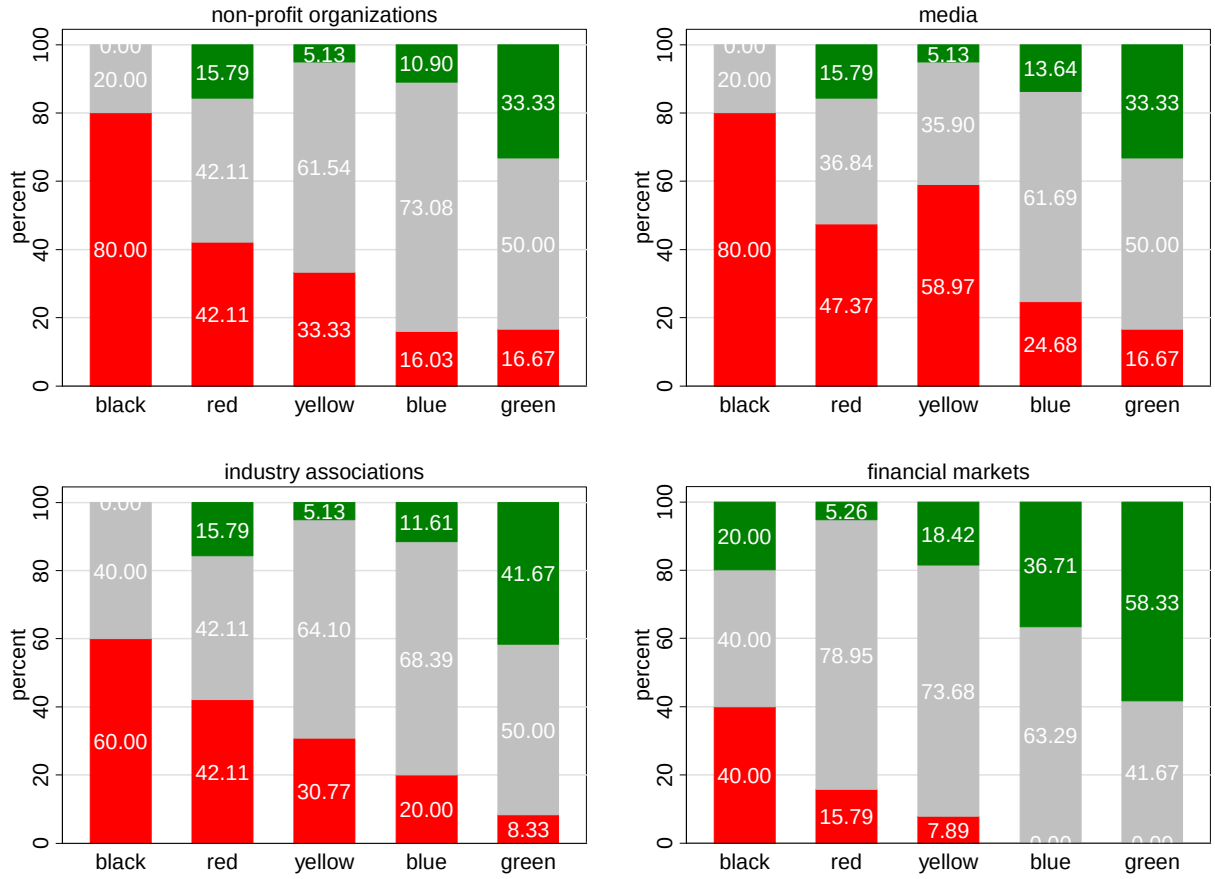
Figure 1. Rating Criteria of the Green Watch Program in China



Source: Revised based on Figure 1 in Wang et al. (2004).

Figure 2. Distribution of the perceived changes in firms' overall market value, market competitiveness, and relationships with different stakeholders by different color ratings





Note: The green, gray and red bars respectively represent one of the three options that the firm managers indicated -- green for “improvement”, gray for “no change” and “red” for “deterioration.” The vertical axis represents the percentage of the firm managers who report the perceived change for each category (improved, no change, or deteriorated). The horizontal axis divides the rated firm into five color ratings.

Appendix A: Major Survey Questions on the Perceived Changes of Green Watch ratings on Firms (the full survey is available upon request)

1. How does your firm's Green Watch rating affect its competitiveness in the international markets (please choose (6) if your firms has no international business)?
   (1) Strongly decrease
   (2) Slightly decrease
   (3) No change
   (4) slightly increase
   (5) Greatly increase
   (6) No international business

2. How does your firm's Green Watch rating affect its competitiveness in the domestic market (please choose (6) if your firm has no domestic business)?
   (1) Strongly decrease
   (2) Slightly decrease
   (3) No change
   (4) slightly increase
   (5) Greatly increase
   (6) No domestic business

3. How does your firms' Green Watch rating affect its competitiveness within the industry?
   (1) strongly decrease
   (2) slightly decrease
   (3) no change
   (4) slightly increase
   (5) greatly increase

4. How does your firms' Green Watch rating affect its overall market value?
   (1) Strongly decrease
   (2) Slightly decrease
   (3) No change
   (4) Slightly increase
   (5) Greatly increase

5. How does your firms' Green Watch rating affect its relationship with financial markets?
   (1) Greatly deteriorated
   (2) Slightly deteriorated
   (3) No change
   (4) Slightly improved
   (5) Greatly improved

6. Is your firm's relationship with environmental authorities affected by its Green Watch rating?
   (1) Greatly deteriorated
   (2) Slightly deteriorated
   (3) No change

(4) Slightly improved
(5) Greatly improved

7. Is your firms' relationship with local communities affected by its Green Watch rating?
   (1) Greatly deteriorated
   (2) Slightly deteriorated
   (3) No change
   (4) Slightly improved
   (5) Greatly improved

8. Is your firms' relationship with industrial associations affected by its Green Watch rating?
   (1) Greatly deteriorated
   (2) Slightly deteriorated
   (3) No change
   (4) Slightly improved
   (5) Greatly improved

9. Is your firms' relationship with environmental non-profit organizations affected by its Green Watch rating?
   (1) Greatly deteriorated
   (2) Slightly deteriorated
   (3) No change
   (4) Slightly improved
   (5) Greatly improved

10. Is your firms' relationship with media affected by its Green Watch rating?
    (1) Greatly deteriorated
    (2) Slightly deteriorated
    (3) No change
    (4) Slightly improved
    (5) Greatly improved

[i] All percentage figures in the rest of the paper refer to percent points.